PE NUMBER: 0602202F
PE TITLE: Human Effectiveness Applied Research

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BUDGET ACTIVITY **02 Applied Research**					PE NUMBER AND TITLE **0602202F Human Effectiveness Applied Research**					
Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
Total Program Element (PE) Cost	111.369	109.174	79.856	79.377	94.344	85.960	88.339	92.936	Continuing	TBD
1123 Warfighter Training	16.992	20.247	13.024	13.850	14.160	14.620	14.929	15.271	Continuing	TBD
7184 Decision Effectiveness & Biosciences	68.731	62.682	48.597	47.368	60.812	53.080	55.151	58.978	Continuing	TBD
7757 Bioeffects and Protection	25.646	26.245	18.235	18.159	19.372	18.260	18.259	18.687	Continuing	TBD

(U) A. Mission Description and Budget Item Justification

This program establishes technical feasibility and develops technology for protecting and enhancing human effectiveness for Air Force weapon systems and for operational readiness. The program addresses warfighter training, deployment and sustainment of forces in extreme environments, warfighter system interface, biodynamic response, directed energy bioeffects, crew performance and protection, and counterproliferation. The Warfighter Training project focuses on the development and evaluation of new methods and technologies to enhance Air Force training and education. The Decision Effectiveness and Biosciences project develops and evaluates technologies that will improve human performance and combat effectiveness. The Bioeffects and Protection project develops technologies to predict and mitigate the biological effects of multiple military unique stressors in extreme environments or during sustained operations, directed energy, and other threats on personnel and mission performance. Note: In FY 2007, Congress added $2.0 million for AIRPRINT, $1.6 million for C4ISR Fusion System, $1.0 million for Bio Medical DNA Program, $1.3 million for Battlefield Automatic Life Status Monitor, $1.0 million for Miniature Tri-Axial Accelerometer, $1.0 million for Eyewear Display for Battlefield Operations, $1.0 million for Unmasking Deception and Denial, $1.0 million for Networked Warfighter Decision Support, $1.1 million for COM Attitude Control System Simulation/Trainer, $4.3 million for Solid Electrolyte Oxygen Separator, and $1.0 million for Warfighter Sustainability: Maximizing Human Performance. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

(U) B. Program Change Summary ($ in Millions)

	FY 2006	FY 2007	FY 2008	FY 2009
(U) Previous President's Budget	108.171	92.991	80.574	84.135
(U) Current PBR/President's Budget	111.369	109.174	79.856	79.377
(U) Total Adjustments	3.198			
(U) Congressional Program Reductions		-0.005		
Congressional Rescissions	-0.074	-0.413		
Congressional Increases		14.500		
Reprogrammings	4.734	2.101		
SBIR/STTR Transfer	-1.462			
(U) Significant Program Changes:				

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Not Applicable.

C. Performance Metrics
Under Development.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research	PROJECT NUMBER AND TITLE 1123 Warfighter Training

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
1123 Warfighter Training	16.992	20.247	13.024	13.850	14.160	14.620	14.929	15.271	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project identifies and analyzes new methods and technologies to improve Air Force training and education. The research focuses on aircrew training; technical training; mission rehearsal; training in support of complex decision-making; information warfare training; and warfighter readiness training. It investigates the spectrum of new and advanced technologies to design and implement training, and to evaluate training effectiveness. It combines fundamental knowledge from the cognitive and neural sciences with information technology to create desktop tutors, courseware development tools and technologies, assessment methodologies, and simulation technologies to achieve maximum learning effectiveness for specific needs at minimum cost. These technologies and methods will increase operational readiness by providing more effective methods and approaches to train and assess personnel. This project contributes to a more highly trained and flexible cadre of personnel at a reduced cost.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Research perceptual issues involving the development of new visual and sensor simulation technologies to enhance Distributed Mission Operations (DMO) and decision dominance environments. Research identifies the visual requirements necessary for realistic aircrew training and mission rehearsal, allowing Air Force warfighters to train as they intend to fight.	1.381	2.693	1.603	2.051

(U) In FY 2006: Researched and analyzed human factor and perceptual issues for off-boresight targeting simulation in DMO multifaceted simulator displays. Evaluated and researched techniques for cockpit, helmet-mounted, and out-the-window visual simulation systems for air-to-ground and composite force training. Identified, researched, and resolved head-mounted and deployable display issues for next generation deployable visual simulation systems. Conducted engineering and human factors analyses of display devices.

(U) In FY 2007: Research and analyze key perceptual performance parameters for new deployable visual display technologies including resolution, image stability, target tracking database characteristics, accuracy, and transport delay. Perform human training research of head-mounted and deployable displays. Research and evaluate visual system requirements for air-to-ground and composite force training.

(U) In FY 2008: Research perceptual issues for out-the-window display and targeting pod simulation systems that will allow for greater realistic composite force training. Explore perceptual characteristics for new deployable visual display technologies. Expand human factors visual research to define display requirements for a fully immersive collaborative environment for DMO.

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(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U) In FY 2009: Complete human factors research, tests, and evaluations of visual system components for air-to-ground and air-to-air composite force training. Conduct perceptual evaluations of deployable display concepts and components. Identify and analyze engineering and perceptual performance visual display concepts for a fully multi-modal immersive environment for DMO. Examine all AF mission areas for training simulation and visual systems applications, and identify key visual science and technology issues.				
(U)				
(U) MAJOR THRUST: Research and analyze tools, strategies, and performance support methods for improving combat mission training, rehearsal, and operations for aircrews and command and control forces. Research provides the combat air forces and global strike operations with the empirical data and guidelines for improving learning in training. Enhances the quality, management, and effectiveness of all aspects of DMO, live operations training, rehearsal and exercise environments through the identification and application of competency-based training methods. Research technologies that will enable DMO and mission rehearsals to run new, complex models/simulations at real- or near real-time. This research will provide vastly improved synthetic forces and aircraft simulator capabilities that feature high fidelity electronic warfare, aerodynamic, and weapons effect models that accurately represent the actual capabilities of both current and future systems and threats.	8.345	9.441	8.037	8.180
(U) In FY 2006: Evaluated integrated learning and readiness assessment models, data, and specifications. Assessed usability of exemplar DMO training scenario design tool. Explored and evaluated virtual environment training syllabi capable of tailoring to individual needs. Investigated fully immersive training environments, with realistic, interactive visual scenery that can be adapted by multiple platforms. Analyzed how spin-up time after brief and extended delays can be reduced with virtual reality training.				
(U) In FY 2007: Evaluate capability to assess learning and proficiency within live, virtual, and constructive operational contexts. Identify metrics and develop preliminary guidelines for initial, refresher, and continuation training and rehearsal. Identify common competency requirements and evaluate instructional designs for common training requirements across operational mission areas. Analyze fully immersive, just-in-time training environments, with realistic, interactive content and training strategies that can be adapted for use within and across missions. Create a learning management-based migration plan for integrating full fidelity training and rehearsal systems with more generalizable software-driven training, rehearsal, and exercise environments.				

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(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U) In FY 2008: Evaluate approaches and tools for integrating principles of learning in live, virtual, and constructive environments. Identify methods and tools to manage learning in operational training contexts. Identify and analyze methods of routinely assessing knowledge and skills for combat readiness. Analyze field data to identify opportunities for competency-based training integration. Analyze how to monitor the integration of distributed training and rehearsal into operational readiness contexts. Evaluate common measurement tools for assessing readiness in air-to-air, air-to-ground, and close air support training, rehearsal, and exercise events. Explore scenario sequencing methods for continuous learning. Conduct in-depth analysis of the training related shortfalls of current DMO computer generated forces. Explore hardware and software solutions allowing functional processing of selected friendly/enemy interactions for extremely high fidelity training. Research and analyze parameters for a network server for high-fidelity weapons models which allows real- or near real-time processing of DMO interactions for more accurate weapons effects and engagements.				
(U) In FY 2009: Develop tools to permit AF planners and managers to integrate competency-based methods into readiness parameters and assessment in operational training, rehearsal, and exercise. Identify alternative approaches for evaluating the individual, team, and team of team (coalition) performance impacts of collaborative, distributed spin-up training and rehearsal. Evaluate integrated instructional development and management methods for continuous learning in DMO and explore task allocation methods for performance aiding and training in operational contexts. Identify functional requirements for instructor operator station capabilities. Investigate and evaluate physics-based directed energy threat models for DMO systems. Define improved rule sets to enhance training utility of computer generated forces. Assess feasibility of enhanced threat avoidance and rehearsal training combining selected aerodynamic models, directed energy models, and validated visual special effects.				
(U)				
(U) MAJOR THRUST: Explore performance improvement techniques to enhance aerospace operational training in realistic mission training environments. Research provides enabling technologies for improving readiness across an assortment of AF career fields, from combat air forces to command and control personnel.	1.720	3.431	3.384	3.619
(U) In FY 2006: Created a communication model through cognitive science principles and techniques to improve the training of AOC airmen. Established computational techniques to predict how the distribution of training opportunities influences the acquisition and long-term retention of complex skills by verifying and validating predictive skill acquisition and decay models with DMO data.				

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(U) **B. Accomplishments/Planned Program ($ in Millions)**	FY 2006	FY 2007	FY 2008	FY 2009
(U) In FY 2007: Integrate the communication model with a synthetic communication agent/teammate and assess training value. Verify and validate the knowledge and skill tracking prediction models with actual training data. Implement initial semi-automated parameter search capability with high performance computing for moderator models.				
(U) In FY 2008: Expand the depth of the communication models to support the full range of vocabulary and grammar used in the AOC training environment. Conduct empirical study with skill acquisition/retention models. Extend automation functionality to include dynamic model validity and refinement capability.				
(U) In FY 2009: Expand the breadth of the communication model to support end-to-end language processing. Integrate knowledge and skill tracking prediction system with mission essential competencies to predict training requirements for airmen and demonstrate ability to produce individualized training programs. Implement graphical user interface for performance moderator prediction system.				
(U)				
(U) CONGRESSIONAL ADD: Airman Performance Integration (AIRPRINT) (previously titled Improved Performance Research Integration Tool (IMPRINT)).	2.432	1.993	0.000	0.000
(U) In FY 2006: Conducted Congressionally-directed effort for IMPRINT.				
(U) In FY 2007: Conduct Congressionally-directed effort for AIRPRINT.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) CONGRESSIONAL ADD: Component Object Model (COM) Attitude Control System Simulation/Trainer.	2.141	1.096	0.000	0.000
(U) In FY 2006: Conducted Congressionally-directed effort for COM Attitude Control System Simulation/Trainer.				
(U) In FY 2007: Conduct Congressionally-directed effort for COM Attitude Control System Simulation/Trainer.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) CONGRESSIONAL ADD: C4ISR Fusion System.	0.973	1.593	0.000	0.000

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(U) B. Accomplishments/Planned Program ($ in Millions)

	FY 2006	FY 2007	FY 2008	FY 2009

(U) In FY 2006: Conducted Congressionally-directed effort for C4ISR Fusion System.
(U) In FY 2007: Conduct Congressionally-directed effort for C4ISR Fusion System.
(U) In FY 2008: Not Applicable.
(U) In FY 2009: Not Applicable.
(U)

(U) Total Cost	16.992	20.247	13.024	13.850

(U) C. Other Program Funding Summary ($ in Millions)

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost

(U) Related Activities:
(U) PE 0602233N, Human Systems Technology.
(U) PE 0602716A, Human Factors Engineering Technology.
(U) PE 0602785A, Personnel Performance and Training Technologies.
(U) PE 0603231F, Crew Systems and Personnel Protection Technology.
(U) PE 0604227F, Distributed Mission Training (DMT).
(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy
Not Applicable.

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BUDGET ACTIVITY 02 Applied Research				PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research			PROJECT NUMBER AND TITLE 7184 Decision Effectiveness & Biosciences		

Cost ($ in Millions)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
7184	Decision Effectiveness & Biosciences	68.731	62.682	48.597	47.368	60.812	53.080	55.151	58.978	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

(U) **A. Mission Description and Budget Item Justification**

This project develops the technology required to identify human impact from deployment, and enhance deployment capabilities, human performance, biodynamic response, and survivability in dispersed operational environments. By investigating the technologies to enhance deployment capabilities this program seeks to improve logistical support for peacetime and combat operations. This research further defines the physical and cognitive parameters, capabilities, and limits of systems operators; it determines human responses to military unique stresses such as operations in sustained and extreme environments including the effects of noise, impact, vibration, and maneuvering acceleration, and it explores ways to assess and manage human operator workload by optimizing the human-machine interface. It produces human-centered design criteria, guidelines, and design tools for developing effective human-system interfaces. It develops and assesses technologies for information display, team communications, and modeling and simulation for human-centered aerospace and cyber operations. It conducts experiments and evaluations of control interfaces, crew station layout and functional integration, and human information processing. It also develops biotechnologies and tools to identify and minimize the risks and mission impact to DoD personnel from exposure to military unique stressors while also reducing human weapon systems life cycle cost.

(U) **B. Accomplishments/Planned Program ($ in Millions)**	FY 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Develop interface technologies that enhance human-human and human-machine collaboration in network-centric warfare environments. These technologies will enable the common operational understanding and shared, distributed decision making required on the modern battlefield.	4.862	5.680	4.990	4.956

(U) In FY 2006: Initiated development of a laboratory prototype of a speech recognizer/synthesizer based on multilingual phoneme acoustic models designed to enhance collaboration between multinational forces. Completed development of human-machine interface style guide and commenced development of a collaboration toolkit, both essential for developing effective warfighter interfaces for air battle management command and control (BMC2). Completed development of an operator cognitive state assessment package that enables real-time human-machine collaboration.

(U) In FY 2007: Determine the risk and benefit of adding language, accent, and domain models into the laboratory speech recognizer/synthesizer, and advance speech processing technology. Complete development of a collaboration toolkit for BMC2. Develop and evaluate BMC2 decision support technologies, and formulate plans to demonstrate operational benefits in an advanced technology program. Demonstrate the ability of the cognitive state assessment package to evaluate real-time human-machine collaboration during simulated BMC2 missions.

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(U) **B. Accomplishments/Planned Program ($ in Millions)**	FY 2006	FY 2007	FY 2008	FY 2009
(U) In FY 2008: Begin to develop multinational speech translator technologies for obscure languages and continue to advance technologies that support mobile, speech-based interfaces. Complete a style guide for applying collaborative tools in BMC2 environments. Begin to develop a collaboration toolkit for non-airborne command and control missions. Expand the operator cognitive state assessor to incorporate operator performance data, operator performance and situational awareness models, and tactical situation information for better decision support.				
(U) In FY 2009: Explore the use of transparent multilingual collaboration tools for distributed multi-entity teaming. Continue to develop multinational speech translation technologies for obscure languages. Determine the effects of collaboration technologies on performance efficiency, shared situation awareness, workload and decision making for tactical command and control. Begin to develop adaptive automated human-machine interfaces to improve real-time human-machine task sharing. Develop predictive operator state models and assessment tools for dynamic workflow and workload management.				
(U)				
(U) MAJOR THRUST: Develop cognitive system interface technologies to achieve common understanding at all echelons of operations and to improve decision-making and predictive battlespace awareness. These technologies offer breakthrough potential for understanding and modeling human behavior, in order to assure timely and effective decisions, while also providing context-sensitive human-computer interfaces that support decision effectiveness.	3.439	4.655	3.977	4.350
(U) In FY 2006: Identified and developed software design patterns that enable the standardization and re-use of human-computer interface elements in command and control ISR systems. Began to develop collaboration techniques that enable diverse users to share a common object representation of the problem domain. Researched the cultural and ethnic bases of human decision-making. Developed methods to represent knowledge about adversaries as a key technology in overcoming barriers that limit effects-based operations.				
(U) In FY 2007: Continue development and begin the transition to advanced development of software design patterns that enable the standardization of human-computer interface elements in command and control ISR systems. Continue to develop collaboration techniques and methods to embed them into command and control systems. Continue researching the cultural and ethnic bases of human decision making and begin to develop human performance models that reflect these differences to enable effects-based operations.				
(U) In FY 2008: Continue advancement of software design patterns that enable the standardization and				

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(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
re-use of human-computer interface elements in command and control ISR systems. Begin to develop a DoD software design patterns library. Continue development of collaboration techniques and methods to embed these techniques into command and control systems. Demonstrate collaboration techniques in a distributed net-centric environment. Continue researching the cultural and ethnic bases of human decision making and proceed with developing human performance models that reflect cultural differences for effects-based operations.				
(U) In FY 2009: Expand contents of DoD software design patterns library. Begin embedding design patterns in graphical user interface building tools. Continue to demonstrate collaboration techniques in a distributed net-centric environment. Investigate how collaboration techniques can enable distributed team self-synchronization. Continue researching the cultural and ethnic bases of human decision making and developing human performance models that reflect cultural differences to enable effects-based operations. Transition select models to advanced development programs.				
(U)				
(U) MAJOR THRUST: Establish the technology base for a decision support environment that enables the Joint Forces Commander, Joint Forces Air Component Commander, and command staffs to interrelate the past, present, and future battlefield mission states and to predict the intent and actions of adversaries during joint operations.	4.164	3.735	1.934	2.284
(U) In FY 2006: Developed advanced visualization techniques that enable the uncertainty associated with information to be incorporated into the iconic or graphic portrayal scheme for command center display. Developed methods to simulate enemy potential courses of action. Initiated development of "sense making" tools for dynamic battlefields. Researched knowledge representation techniques to model potential adversaries and complex systems of systems. Initiated development of a set of integrated work aids that will support a commander's decision-making in a future environment of continuous Anticipatory Planning and Operations (APO).				
(U) In FY 2007: Continue developing advanced visualization techniques that enable the uncertainty associated with information to be incorporated into the iconic or graphic portrayal scheme for command center display. Continue to develop, and begin to transition to advanced development, methods needed to simulate enemy potential courses of action, beginning with simple models of adversary behavior. Conduct laboratory experiments to evaluate "sensemaking" tools and displays for dynamic battlefields. Continue to develop knowledge representation techniques to model potential adversaries and complex systems of systems. Continue to develop an integrated set of APO work aids to achieve persistent				

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(U) **B. Accomplishments/Planned Program ($ in Millions)**	FY 2006	FY 2007	FY 2008	FY 2009

operational planning, persistent prediction, and focused execution even as military and broad national security objectives are dynamically changing.

(U) In FY 2008: Begin the transition of advanced uncertainty visualization techniques for command center displays. Transition towards advanced development, the needed methods to simulate enemy potential courses of action, including more complex adversary behavior. Evaluate results of the laboratory experiments on "sensemaking" tools and displays for dynamic battlefields. Identify gaps for further research. Begin incorporating the extrapolated, select "sensemaking" results into display development. Refine the knowledge representation techniques to model potential adversaries and complex systems of systems and begin integrating into displays. Initiate transition of integrated set of APO work aids to achieve persistent operational planning, persistent prediction, and focused execution. Conduct initial demonstration of the integration of the developed displays and technologies.

(U) In FY 2009: Analyze the results of the initial demonstration of the integration of the displays and technologies. Complete the transition of advanced uncertainty visualization techniques for command center display. Continue transition of methods needed to simulate enemy potential courses of action, including more complex adversary behavior. Incorporate more extrapolated "sensemaking" results into displays. Refine the knowledge representation techniques to model potential adversaries and complex systems of systems and begin integrating into displays. Continue transitioning the integrated set of APO work aids to achieve persistent operational planning, persistent prediction, and focused execution and evaluate the effect. Conduct follow-on demonstration of the integration of the developed displays and technologies.

(U)

	FY 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Develop system control interface concepts enabling full operator exploitation of all platform capabilities. Identify the best mix of intelligent methods and traditional design to unambiguously direct the operator's attention, which is critical for net-centric operations. Employ real-time and wargaming simulations to quantify operational benefits from new information portrayal concepts.	4.503	4.845	4.705	4.477

(U) In FY 2006: Using virtual simulation, evaluated decision support interface concepts to enable single operator supervision of multiple semi-autonomous unmanned systems. For unmanned combat air vehicles, evaluated first generation control-display concepts that reduce operator task load and mitigate channelized attention. Developed fusion algorithms that combine on-board and off-board sensor data with imagery. Explored the integration of computer-generated pictures with sensor images to enable

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(U) **B. Accomplishments/Planned Program ($ in Millions)**	FY 2006	FY 2007	FY 2008	FY 2009
autonomous approach and landing.				
(U) In FY 2007: Demonstrate real-time assessment tools and advanced decision support interfaces, including prediction capability, for maximizing single operator supervision of multiple highly autonomous unmanned aerial vehicles (UAVs) within net-centric environments. Begin design and development of second generation control-display concepts that reduce operator task load and mitigate channelized attention. Begin algorithm development to blend display imagery with computer-generated graphical representations of terrain and real-time data to conduct autonomous landing and ground operations at night and during adverse weather.				
(U) In FY 2008: Evaluate single operator supervision of multiple autonomous UAVs in a net-centric context using real-time assessment tools and advanced decision support interfaces during testing and simulated ground operations. Transition field test results of first generation control-display concepts that reduce operator task loading and channelized attention into second generation control-display workstations. Apply basic algorithms that blend display imagery with computer-generated graphical representations of terrain and real-time data during simulation and/or fight-testing of autonomous landing and ground operations.				
(U) In FY 2009: Integrate real-time assessment tools into second generation control-display operator workstations to optimize operator task loading and avoid channelized attention. Use second generation operator workstations during field testing and flight demonstration to control multiple, highly autonomous UAVs. Begin software design and development of common interface and software architectures of control-display concepts that allow minimal numbers of operators to control autonomous UAVs in urban environments and/or in large-scale, strategic military operations.				
(U)				
(U) MAJOR THRUST: Develop technologies associated with collecting and optimizing visually displayed information for best assimilation by warfighters. Develop, evaluate, and organize algorithms for enhancing input to the visual system through the fusion of multi-spectral sensors, digital image processing, and solid-state display technologies in order to enhance real-time, day/night imaging systems. Devise human-centered command and control symbology and techniques for integration with visual displays, permitting natural situation understanding of complex information rich environments.	5.117	4.385	4.723	4.570
(U) In FY 2006: Developed algorithms to electronically enhance vision when using head-mounted solid state imagers. Evaluated those algorithms using realistic simulations of warfighter visual tasks. Developed methods to depict command and control and other complex types of information in intuitive,				

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(U) **B. Accomplishments/Planned Program ($ in Millions)**	FY 2006	FY 2007	FY 2008	FY 2009
easy-to-understand ways.				
(U) In FY 2007: Evaluate and improve algorithms to electronically enhance vision when using head-mounted solid state imagers. Improve methods to depict command and control and other complex types of information in intuitive, easy-to-understand ways. Evaluate the methods using realistic simulations of the targeted combat environments.				
(U) In FY 2008: Down-select and implement image-enhancing algorithms that are optimized for speed, visual performance, and real-time tactical use. Develop a laboratory-grade test bed usable to perform field tests. Continue to develop and evaluate new and innovative ways to visualize and interact with large amounts of information in visually rich environments. Evaluate display symbologies and mechanizations in simulated Air and Space Operations Center environments.				
(U) In FY 2009: Perform multispectral, real-time field evaluations of display algorithm sets that have been optimized for different tactical scenarios. Refine visualization and interaction techniques to enhance decision-making by testing more intuitive symbology and user interfaces. Test these methods against current state-of-the-art to prove and improve total system effectiveness. Begin to develop visualization technologies that enhance situational awareness and battlespace understanding in command centers of the future.				
(U)				
(U) MAJOR THRUST: Develop advanced audio display technologies for human-to-human collaboration including three-dimensional (3-D) audio, active noise reduction, and related technologies that mitigate effects of noise and enhance performance and information processing in the operational environment. In particular, these battlespace acoustic interfaces will integrate with warfighter equipment and amplify information delivery to the warfighter.	3.915	4.361	3.958	3.794
(U) In FY 2006: Researched acoustic signal control to improve human-to-human communications through noise reduction systems and improved acoustic signal processing. Explored the value of acoustic modeling for operational analysis. Analyzed how to minimize acoustic detection of vectored thrust aircraft. Developed auditory information aiding technologies to improve collaboration in operational command and control environments. Explored how the novel use of ultrasonic auditory projection can enhance command and control operations.				
(U) In FY 2007: Continue to research acoustic signal control to improve human-to-human communications in operational environments by improving noise reduction technologies and use of acoustic signal processing to improve information gathering for security forces. Begin to research methods to				

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(U) **B. Accomplishments/Planned Program ($ in Millions)**	FY 2006	FY 2007	FY 2008	FY 2009
incorporate weather effects on noise propagation and ways to represent weather effects in dynamic noise models. Continue to develop auditory information aiding technologies for remote collaboration. Explore how to improve audio symbology for streamlining command and control operations including 3-D audio symbology. Begin to explore the human processes that lead to communication breakdown.				
(U) In FY 2008: Explore the potential of acoustic aiding during urban operations to improve machine-to-human communications by using acoustic signal processing to improve security forces' information gathering. Begin to research ways to adapt current noise models to enhance decision-making and acoustic detectability during offensive operations. Continue to develop auditory information-aiding technologies for remote collaboration, by exploiting advances in communication theory for individuals. Continue to explore the individual and group processes that lead to communication breakdown. Explore improved auditory sensing to create virtual auditory reality for human interface to remote sensing.				
(U) In FY 2009: Develop acoustic aiding for urban operations to improve machine-to-human communications by using ultrasonic and laser technology advances to improve security forces' information gathering. Continue to research methods and develop models to predict acoustic detectability under dynamic conditions for improved offensive operations. Continue to develop auditory information-aiding technologies for remote collaboration by exploiting advances in communication theory for individuals. Continue to explore the individual and group processes that lead to communication breakdown. Improve auditory sensing technology to create virtual auditory reality for human interface to remote sensing, emphasizing its application to security forces.				
(U)				
(U) MAJOR THRUST: Develop integrated human-centered Information Operations (IO) and Intelligence, Surveillance, and Reconnaissance (ISR) technologies to provide quicker and more intuitive access to information, enhanced decision-making capabilities, more effective training procedures, and improved tools for IO/ISR operators' use in performing their respective missions.	8.947	11.375	9.149	10.215
(U) In FY 2006: Conducted research to develop better visualization for spectral data exploitation and to improve predictive battlespace awareness capabilities. Developed next stage of proof-of-concept technologies to specify, measure, and model key parameters.				
(U) In FY 2007: Conduct research and implementation of models for IO and ISR. Develop conceptual human system interfaces for additional Measurement and Signatures Intelligence (MASINT) capabilities, specifically in the spectral area. Develop tools and models for assessing the effectiveness of				

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(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009

(U)   influence operations. Complete development of proof-of-concept technologies to specify, measure, and model key parameters. Research and develop counter-Improved Explosive Device (IED) concepts/devices.

(U)   In FY 2008: Validate conceptual human-system interfaces for additional MASINT capabilities. Develop and validate tools and models for assessing the effectiveness of influence operations. Continue research and development of tools and capabilities for Influence Operations and counter-Influence Operations. Continue development of tools and models for assessing the effectiveness of influence operations. Continue research and validation of speech-to-speech translation tool. Develop capability to anticipate adversarial behavior, both individually and in groups. Continue counter-IED research.

(U)   In FY 2009: Continue development and validation of advanced IO/Influence Operations research tools and training techniques to enable increased offensive and defensive combat capabilities which counter asymmetric adversarial threats. Validate and complete IO/Influence Operations models and simulation capabilities. Develop and validate prototype of advanced speech-to-speech translation tool. Continue development of capability to anticipate adversarial behavior, both individually and in group, with application in the psychological operations domain. Continue counter-IED research. Develop collaborative tools and training for ISR team applications with emphasis on distributed operations.

(U)

(U)   MAJOR THRUST: Develop human injury criteria and protective system technologies to provide sanctuary from injury and disability causing threats to military personnel. Research will develop technologies to ensure accommodation and safety of all airmen during military operations, such as flight, ground patrols, crashes, emergency escape, extended missions, and parachute opening shock.

                                                      5.455   5.721   4.487   4.125

(U)   In FY 2006: Using available safety and medical databases, evaluated and began addressing primary AF injury and physical health effects causes. Defined criteria functions to relate seat cushion comfort to measurable parameters for use in seating requirements. Developed initial collaborative information system for analyzing environmental threats and developing immunity strategies. Investigated the effects and interrelationships between equipment fit, workload, marginal anthropometry, and physical capability.

(U)   In FY 2007: Develop injury criterion for multi-axial dynamic neck loading and standards for gender and demographics. Determine the effects and interrelationships between equipment fit, workload, marginal anthropometry, physical capability, cognitive capability, and increased equipment loads on pilot crew performance. Using risk-based analysis, identify primary musculoskeletal disability causes

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(U) **B. Accomplishments/Planned Program ($ in Millions)**	FY 2006	FY 2007	FY 2008	FY 2009

(U) and begin addressing equipment, procedure, or physical training improvements. Develop initial data mining and analysis tools for searching across biomechanics, safety, and medical information systems.

(U) In FY 2008: Conduct focused injury surveillance studies on specific career fields and assignments to identify those that have high rates of injury and disability. Based on these studies, begin developing technologies to reduce musculoskeletal disabilities and injuries due to personal equipment and workstation designs. Develop procedures and training improvements to reduce high training attrition due to injury, especially focused on battlefield airmen training. Expand initial biomechanics collaborative information system to coordinate DoD biomechanics data collections and analysis capabilities.

(U) In FY 2009: Optimize equipment technologies, refine procedures, and improve training processes to address the most common AF job-related injuries and disabilities. Extend these improvements to not only prevent injuries but also to optimize human performance. Develop workstation design criteria to maximize operator performance and minimize fatigue, based on interrelationships between equipment fit, workload, anthropometry, physical capability, and cognitive capability. Use the biomechanics collaborative information technologies to collect and analyze biometric data for the purpose of friend or foe personnel identification in hostile environments.

(U)

(U) MAJOR THRUST: Quantify and model operator performance in stressful environments and develop technologies to mitigate the effects of operational stressors on cognitive function, safety, and mission effectiveness. Develop solutions to enhance human performance and ensure combat effectiveness in AF operations.

	FY 2006	FY 2007	FY 2008	FY 2009
MAJOR THRUST	1.562	1.540	2.004	0.538

(U) In FY 2006: Investigated asymmetric helmet loads in high-G environment and assessed effects on helmet aiming and pointing. Incorporated cognitive model into wargaming scenarios and simulation-based acquisition.

(U) In FY 2007: Develop concepts to reduce effects of heavy flight helmets in the high-G environment. Complete validation and transition of high-G cognitive model for simulation-based acquisition. Explore biobehavioral technologies to augment cognition and enhance operator performance.

(U) In FY 2008: Continue behavioral research to characterize human performance and mitigate cognitive degradation during demanding military operations. Develop real-time biobehavioral performance monitoring technology to evaluate cognitive readiness and decision making in command and control applications, tactical operations, and mission rehearsal. Explore emerging cognitive disruption

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(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
technologies and potential countermeasures.				
(U) In FY 2009: Continue behavioral neuroscience research to characterize and mitigate human cognitive degradation during demanding military operations. Refine real-time biobehavioral performance monitoring technology and develop operational employment concepts. Continue to investigate cognitive disruption technologies and potential countermeasures.				
(U)				
(U) MAJOR THRUST: Develop, demonstrate, and apply experimental models for predicting toxicological compromises in human mission performance and create in-house and field methods to assure protection of AF personnel from toxic hazards and exposures in Joint operational environments. Using integrated biological approaches, create predictive algorithms to describe functional cellular dynamics and engineering constructs for advancing detection and performance of AF systems. Improve commander decision-making ability to properly balance mission and force protection requirements.	0.816	2.062	1.779	1.560
(U) In FY 2006: Developed procedures and computer simulation models to predict effects of toxic compound and nanomaterial exposure on Air Expeditionary Forces and improve the protection of Air Force personnel in operational environments. Developed and demonstrated algorithms to describe the function of cellular dynamics with the potential for improved logic and sensor effectiveness for AF systems.				
(U) In FY 2007: Apply procedures and computer simulation models to predict effects of toxic compound and nanomaterial exposure on Air Expeditionary Forces and improve the protection of AF personnel in operational environments. Further develop and demonstrate algorithms to describe the function of cellular dynamics with the potential for improved logic and sensor capability for Air Force systems.				
(U) In FY 2008: Develop and apply procedures and computer simulation models to predict effects of large volume material, toxic compound, and nanomaterial exposure on Joint Service and Air Expeditionary Forces. Using computer modeling and integrated biological approaches to understand functional cellular dynamics and engineering, explore and create integrated new sensor and material constructs for AF applications.				
(U) In FY 2009: Further develop procedures and computer simulation models to predict effects of toxic compound and nanomaterial exposure on Joint Service and Air Expeditionary Forces. Using computer modeling and systems biology approaches to understand functional cellular dynamics and engineering, continue to explore and create integrated new sensor and material constructs for AF applications.				
(U)				

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(U) **B. Accomplishments/Planned Program ($ in Millions)**	FY 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Develop biotechnologies to identify warfighter exposures to hazardous agents before they result in illness or a reduction in mission performance, thus greatly improving force protection and the probability of mission success.	4.881	5.844	4.098	3.467
(U) In FY 2006: Conducted genomic, proteomic, and metabolite studies to identify target-organ biomarkers in body fluids of the deployed airmen exposed to hazardous agents. Assessed kidney and liver organ response biomarker patterns for early detection of the effects of unknown hazardous agents on AF personnel.				
(U) In FY 2007: Continue to conduct genomic, proteomic, and metabolite studies to identify target-organ biomarkers in body fluids of the deployed airmen exposed to hazardous agents. Complete kidney and assess liver organ response biomarker patterns for early detection of the effects of unknown hazardous agents on AF personnel.				
(U) In FY 2008: Continue to conduct genomic, proteomic, and metabolite studies to identify target-organ biomarkers and their assessment methods for hazardous agent exposure. Complete validation panel for selected kidney biomarkers and down-select liver organ response biomarker patterns for early detection of the effects of unknown hazardous agents on AF personnel.				
(U) In FY 2009: Complete genomic, proteomic, and metabolite studies to identify and validate kidney and liver biomarkers of hazardous agent exposure in deployed airmen. Extend program to investigate connective tissue, lung, and brain biomarkers of degradation from hazardous agent exposure in AF personnel.				
(U)				
(U) MAJOR THRUST: Develop logistics readiness technology options and perform feasibility studies to support large-scale advanced technology development programs. These technologies will lead to more efficient utilization of logistics resources for Air Expeditionary Force operations.	1.901	2.203	2.793	3.032
(U) In FY 2006: Completed examination of new techniques to identify both functional and system requirements. Investigated and applied new information presentation techniques for future logistics and maintenance software tools. Defined "sense-respond" capabilities which will promote effects-based logistics through a common operating picture. Developed methods of quantifying levels of success of logistics and maintenance operations in support of flying missions.				
(U) In FY 2007: Continue to investigate and apply new techniques for future logistics and maintenance technical data presentation and for task/job aiding and training. Complete work on defining sense-respond capabilities which promote effects-based logistics using a net-centric environment.				

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(U) **B. Accomplishments/Planned Program ($ in Millions)**	FY 2006	FY 2007	FY 2008	FY 2009
Identify technology gaps to meet previously defined emergency response logistics requirements.				
(U) In FY 2008: Investigate methods for performance measurement and evaluation of augmented reality, virtual reality, and versatile media formats in packaging and delivering job/task aiding and training solutions for maintenance work. Investigate integration mechanisms for these human-centered technologies with on-board diagnostic/health monitoring technologies to promote more accurate system repair processes at the point of maintenance.				
(U) In FY 2009: Further explore and apply integrated, multifunction job aiding concepts in laboratory and controlled field tests. Investigate the usefulness of collaboration support for troubleshooting and complex field repair problems. Explore the hardware, software, and packaging issues for combined job aid and on-the-job training devices for maintenance work.				
(U)				
(U) CONGRESSIONAL ADD: Special Operations Target Acquisition and Control Suite (SO-TACS).	1.362	0.000	0.000	0.000
(U) In FY 2006: Conducted Congressionally-directed effort for SO-TACS.				
(U) In FY 2007: Not Applicable.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) CONGRESSIONAL ADD: Bacterial Ghost Vaccine for Influenza Virus.	0.973	0.000	0.000	0.000
(U) In FY 2006: Conducted Congressionally-directed effort for Bacterial Ghost Vaccine for Influenza Virus.				
(U) In FY 2007: Not Applicable.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) CONGRESSIONAL ADD: Flexible Display and Integrated Communication Device for the BAO.	0.973	0.000	0.000	0.000
(U) In FY 2006: Conducted Congressionally-directed effort for Flexible Display and Integrated Communication Device for the BAO.				
(U) In FY 2007: Not Applicable.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				

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(U) **B. Accomplishments/Planned Program ($ in Millions)**	FY 2006	FY 2007	FY 2008	FY 2009
(U) CONGRESSIONAL ADD: Carbon Nanostructured Material for Fluid Purification.	4.866	0.000	0.000	0.000
(U) In FY 2006: Conducted Congressionally-directed effort for Carbon Nanostructured Material for Fluid Purification.				
(U) In FY 2007: Not Applicable.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) CONGRESSIONAL ADD: Fused Carbon Nanotube Material for Fluid Purification.	2.432	0.000	0.000	0.000
(U) In FY 2006: Conducted Congressionally-directed effort for Fused Carbon Nanotube Material for Fluid Purification.				
(U) In FY 2007: Not Applicable.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) CONGRESSIONAL ADD: Rapid ID and Treatment for Air Force Medical Service.	0.973	0.000	0.000	0.000
(U) In FY 2006: Conducted Congressionally-directed effort for Rapid ID and Treatment for Air Force Medical Service.				
(U) In FY 2007: Not Applicable.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) CONGRESSIONAL ADD: Warfighter Pocket XP Project.	4.282	0.000	0.000	0.000
(U) In FY 2006: Conducted Congressionally-directed effort for Warfighter Pocket XP Project.				
(U) In FY 2007: Not Applicable.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) CONGRESSIONAL ADD: Networked Warfighter Decision Support.	1.362	0.996	0.000	0.000
(U) In FY 2006: Conducted Congressionally-directed effort for Networked Warfighter Decision Support.				
(U) In FY 2007: Conduct Congressionally-directed effort for Networked Warfighter Decision Support.				
(U) In FY 2008: Not Applicable.				

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(U) **B. Accomplishments/Planned Program ($ in Millions)**	FY 2006	FY 2007	FY 2008	FY 2009
(U) In FY 2009: Not Applicable.				
(U)				
(U) CONGRESSIONAL ADD: Bio Medical DNA Program.	0.973	0.996	0.000	0.000
(U) In FY 2006: Conducted Congressionally-directed effort for Bio Medical DNA Program.				
(U) In FY 2007: Conduct Congressionally-directed effort for Bio Medical DNA Program.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) CONGRESSIONAL ADD: Eyewear Display for Battlefield Operations.	0.973	0.996	0.000	0.000
(U) In FY 2006: Conducted Congressionally-directed effort for Eyewear Display for Battlefield Operations.				
(U) In FY 2007: Conduct Congressionally-directed effort for Eyewear Display for Battlefield Operations.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) CONGRESSIONAL ADD: Battlefield Automatic Life Status Monitor.	0.000	1.296	0.000	0.000
(U) In FY 2006: Not Applicable.				
(U) In FY 2007: Conduct Congressionally-directed effort for Battlefield Automatic Life Status Monitor.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) CONGRESSIONAL ADD: Miniature Tri-Axial Accelerometer.	0.000	0.996	0.000	0.000
(U) In FY 2006: Not Applicable.				
(U) In FY 2007: Conduct Congressionally-directed effort for Miniature Tri-Axial Accelerometer.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) CONGRESSIONAL ADD: Unmasking Deception and Denial.	0.000	0.996	0.000	0.000
(U) In FY 2006: Not Applicable.				
(U) In FY 2007: Conduct Congressionally-directed effort for Unmasking Deception and Denial.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				

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(U) **B. Accomplishments/Planned Program ($ in Millions)**	FY 2006	FY 2007	FY 2008	FY 2009
(U)				
(U) Total Cost	68.731	62.682	48.597	47.368

(U) **C. Other Program Funding Summary ($ in Millions)**

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U) Related Activities:										
(U) PE 0602201F, Aerospace Flight Dynamics.										
(U) PE 0602204F, Aerospace Sensors.										
(U) PE 0602702F, Command, Control, and Communications.										
(U) PE 0603205F, Flight Vehicle Technology.										
(U) PE 0603231F, Crew Systems and Personnel Protection Technology.										
(U) PE 0603245F, Flight Vehicle Technology Integration.										
(U) PE 0604706F, Life Support Systems.										
(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.										

(U) **D. Acquisition Strategy**
 Not Applicable.

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Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
7757 Bioeffects and Protection	25.646	26.245	18.235	18.159	19.372	18.260	18.259	18.687	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

The project assesses the bioeffects of directed energy for force protection, special operations, military operations other than war, and peacekeeping applications; and provides tailored/agile human performance optimization technologies to confront asymmetric threats. The project enables the safe operational use of AF aerospace systems through technology developments that ameliorate/counter/exploit the biological effects of operational stressors and other threats. It addresses areas such as safety, risk assessment, mission planning, countermeasures, personnel protection, and counterproliferation research, technology development, and validation.

(U) B. Accomplishments/Planned Program ($ in Millions)

	FY 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Conduct laboratory experiments and field research on laser bioeffects, enabling military exploitation of laser technology while providing countermeasures for optical hazards/threats.	5.648	6.779	6.354	6.419

(U) In FY 2006: Evaluated impacts of multi-wavelength lasers upon the human visual system. Developed technologies to improve combat vision, including laser eye protection. Completed bioeffects studies and submitted recommendations for revisions to national and international safety standards in the near infrared based on laboratory data and validated models. Explored the use of biotechnology as an adjunct to human protection from certain laser exposures.

(U) In FY 2007: Continue developing technologies to improve combat vision, including human factors methodologies. Provide laser eye protection in an integrated format. Continue to evaluate impacts of multi-wavelength lasers upon the human visual system. Develop robust modeling and simulation programs and first approximations of near real-time probabilistic risk assessment tools. Develop first models of dynamic bi-directional reflectivity distribution function for laser scatter for high energy laser applications.

(U) In FY 2008: Integrate dynamic bi-directional reflectivity distribution mathematical models into diagnostic tools of laser eye damage for collateral hazard assessments of typical laser systems. Expand laser damage threshold database for multiple wavelengths to validate DoD, national, and international safety standards. Evaluate impact of visible lasers upon critical aircrew and ground force missions.

(U) In FY 2009: Perform field and laboratory experiments to verify and validate optical physics model of bi-directional reflectivity distribution calculations for use as high energy laser collateral hazard assessment tool. Integrate collateral hazard assessment software model into airborne laser platform performing high energy laser system demonstrations. Initiate experiments for future high energy laser weapon systems to predict, evaluate, and explore target bioeffects.

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(U) **B. Accomplishments/Planned Program ($ in Millions)**	FY 2006	FY 2007	FY 2008	FY 2009
(U)				
(U) MAJOR THRUST: Conduct electromagnetic (EM) field bioeffects laboratory experiments and field research to enable the safe exploitation of directed energy technologies for communication, target identification, and weapons development while identifying countermeasures to EM hazards/threats.	5.265	6.570	6.089	5.739
(U) In FY 2006: Evaluated the bioeffects of emerging directed energy weapons to assess safety and effectiveness. Extended laboratory and field assessment techniques into the terahertz range. Developed new modeling tool to assess potential risks of millimeter waves. Refined modeling and simulation tools to evaluate the human health, behavior, and performance impacts of high frequency EM systems. Evaluated effects of high power and high peak power EM systems using biotechnology. Conducted research to support scientifically-based human exposure standards.				
(U) In FY 2007: Further refine methods to evaluate the bioeffects of directed energy weapons and support safety and effectiveness assessments of emerging directed energy weapons. Continue to extend laboratory and field assessment techniques into the terahertz range. Continue to enhance modeling and simulation tools to evaluate the human health, behavior, and performance impact of high frequency EM systems. Continue to evaluate human health in response to high power and high peak power EM systems using biotechnology. Continue to conduct research to support scientifically-based human exposure standards.				
(U) In FY 2008: Explore tissue interactions from terahertz frequencies to evaluate safe exposure levels and tissue vulnerabilities. Improve EM tissue models to include terahertz and high power EM effects. Continue research to support fielding and effectiveness of radio frequency (RF) directed energy weapon systems.				
(U) In FY 2009: Conduct experiments to refine and eliminate gaps in RF exposure standards for microwave, ultra-wide band, and high peak power RF systems. Integrate and improve human behavior, bioeffects, and target effects computer models based on RF studies in microwave, ultra-wide band, high peak power, and terahertz sources. Investigate RF bioeffects as a foundation for future RF weapons.				
(U)				
(U) MAJOR THRUST: Develop biotechnologies to accurately and affordably support the detection, identification, neutralization, and assessment of threat agents. Perform counterproliferation research to enable air operations to continue in the most efficient manner.	3.320	5.624	4.032	3.980
(U) In FY 2006: Developed technologies to identify the production source of threat agents. Developed methods to assess the viability and activity of threat agents and continued counterproliferation research				

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(U) **B. Accomplishments/Planned Program ($ in Millions)**	FY 2006	FY 2007	FY 2008	FY 2009
to predict and minimize collateral damage.				

(U) In FY 2007: Continue to develop technologies to identify the production source of threat agents. Continue to develop and validate methods to assess the viability of threat agents after active countermeasures have been employed. Refine counterproliferation research to better predict and further minimize collateral damage.

(U) In FY 2008: Continue to develop and validate methods to assess the viability and activity of threat agents after active countermeasures have been employed. Begin to develop technologies that will enable the AF to locate biological warfare agents behind walls and inside of containers. Characterize organic semiconductor material interactions with directed energy to enhance agent neutralization capabilities.

(U) In FY 2009: Refine viability assessment technologies and develop models that predict plume distribution patterns to minimize collateral damage from counterforce weapon detonations. Continue to develop advanced biological taggant technologies that will locate biological warfare agents behind walls and in containers. Investigate counterproliferation technologies capable of effectively neutralizing genetically modified biological threat agents.

(U)

	FY 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Develop novel technology solutions integrating behavioral psychology, metabolomic research, nutritional strategies, and personal protective technologies to enable human performance optimization in multiple stressor environments. Results will optimize operational execution through increased human effectiveness, reduced attrition/lost training days, and faster post-mission recovery.	1.366	1.630	1.760	2.021

(U) In FY 2006: Refined and tested fatigue model to expand performance predictions for additional air and space applications. Identified and assessed novel fatigue countermeasures and associated delivery mechanisms to improve human performance in specific operational aerospace environments. Developed and demonstrated modeling of fatigue interventions.

(U) In FY 2007: Investigate individual differences in human performance variability and response to performance optimizing interventions. Extend individual performance research to quantify effects of workload distribution, task novelty, and experience on collaborative team performance in a cognitively demanding environment. Develop methodologies to tailor behavioral and physiological regimens to achieve flexible task-based human performance capabilities.

(U) In FY 2008: Continue to develop methodologies to tailor behavioral and physiological regimens and integrate revolutionary concepts in metabolomics/human performance technologies with existing

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(U) **B. Accomplishments/Planned Program ($ in Millions)**	FY 2006	FY 2007	FY 2008	FY 2009
training/operations. Continue research to quantify effects of workload distribution, task novelty, and experience on team performance in a cognitively demanding environment.				
(U) In FY 2009: Continue development and assess benefit of tailored/agile human performance optimization regimens to confront asymmetric threats. Expand biobehavioral performance models to incorporate individual differences in human performance vulnerability.				
(U)				
(U) MAJOR THRUST: Develop technologies and procedures to counter physiological effect of high altitude flight, improve pilot performance under high, rapid-onset gravitational forces, and deliver oxygen. Research will enhance airman safety during global attack, global mobility, and special operations missions. Note: Effort terminates in FY 2007 due to higher AF priorities.	0.414	0.362	0.000	0.000
(U) In FY 2006: Evaluated advanced materials and innovative design concepts to reduce bulk and thermal burden of aircrew protective equipment. Completed Altitude Decompression Sickness (DCS) math model and transitioned mission planning risk assessment tool to ACC and AFSOC. Quantified performance characteristics of oxygen systems technologies for multiple special operations scenarios.				
(U) In FY 2007: Evaluate ability of candidate integrated aircrew ensemble technology components to address identified life support equipment deficiencies. Continue assessment of oxygen generation systems technology effectiveness in a chemical environment.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) CONGRESSIONAL ADD: Genetics of Sleep Deprivation and Fatigue.	0.973	0.000	0.000	0.000
(U) In FY 2006: Conducted Congressionally-directed effort for Genetics of Sleep Deprivation and Fatigue.				
(U) In FY 2007: Not Applicable.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) CONGRESSIONAL ADD: Nanoparticles Directed by DNA Capture Elements for the Detection and Neutralization of Bioterrorist Agents.	1.264	0.000	0.000	0.000
(U) In FY 2006: Conducted Congressionally-directed effort for Nanoparticles Directed by DNA Capture Elements for the Detection and Neutralization of Bioterrorist Agents.				
(U) In FY 2007: Not Applicable.				

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602202F Human Effectiveness Applied Research**	PROJECT NUMBER AND TITLE **7757 Bioeffects and Protection**

(U) **B. Accomplishments/Planned Program ($ in Millions)**	FY 2006	FY 2007	FY 2008	FY 2009
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) CONGRESSIONAL ADD: Solid Electrolyte Oxygen Separator (SEOS).	4.672	4.284	0.000	0.000
(U) In FY 2006: Conducted Congressionally-directed effort for SEOS.				
(U) In FY 2007: Conduct Congressionally-directed effort for SEOS.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) CONGRESSIONAL ADD: Warfighter Sustainability: Maximizing Human Performance.	2.724	0.996	0.000	0.000
(U) In FY 2006: Conducted Congressionally-directed effort for Warfighter Sustainability: Maximizing Human Performance.				
(U) In FY 2007: Conduct Congressionally-directed effort for Warfighter Sustainability: Maximizing Human Performance.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) Total Cost	25.646	26.245	18.235	18.159

(U) **C. Other Program Funding Summary ($ in Millions)**

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U) Related Activities:										
(U) PE 0602720A, Environmental Quality Technology.										
(U) PE 0603231F, Crew Systems and Personnel Protection Technology.										
(U) PE 0604617F, Agile Combat Support.										
(U) PE 0604706F, Life Support Systems.										

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Exhibit R-2a, RDT&E Project Justification	DATE **February 2007**

BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602202F Human Effectiveness Applied Research**	PROJECT NUMBER AND TITLE **7757 Bioeffects and Protection**

(U) **C. Other Program Funding Summary ($ in Millions)**

(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

(U) **D. Acquisition Strategy**
   Not Applicable.